Before the
Federal Communications Commission
Washington, D.C. 20554

	§	
In the Matter of	§	
	§	PS Docket No. 07-114
Revision of the Commission's Rules to Ensure	§	
Compatibility with Enhanced 911 Emergency	§	
Calling Systems.	§	
	§	

COMMENTS OF NENA: THE 9-1-1 ASSOCIATION

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COMMENTS OF NENA: THE 9-1-1 ASSOCIATION[1]

NENA feels the Commission's proposed 9-1-1 vertical accuracy requirements are reasonable, but we strongly urge the Commission to consider the following major points:

- Dispatchable location, as defined, is not the most accurate, useful, or efficient means to locate an individual and the Commission should not include dispatchable location, as defined,[2] in its rules.
- Geodetic location information provides the best information for 9-1-1 to locate a caller.
- The location of a caller must be delivered to the 9-1-1 system as a standards-based, interoperable Location Object, carried over IP and expressed as a geodetic Location Object which includes the Commission's proposed z-axis measurement.
- CTIA's most recent ex parte filing, when viewed in light of location capabilities commercially available on the market today, calls into question the NEAD's future viability.

As an initial matter, NENA has strong reservations regarding a requirement for OSP-delivered dispatchable location. It may seem intuitive at first that the best requirement is to guide the first responder to the correct door: a civic address and suite or apartment number. Accordingly, it may seem intuitive to establish a requirement that the OSP should provide an address and apartment number, which in turn, tells the first responder which door to go to.[3] That is what dispatchable location is. It is a door.

However, we must carefully consider how each component of the call origination and delivery process works; and accordingly consider the telecommunicator, the NG9-1-1 or 9-1-1 system, the originating network, the device, and the location services the device uses. A door is not where a person is

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[1] NENA: The 9-1-1 Association improves 9-1-1 through research, standards, development, training, education, outreach, and advocacy. Our vision is a public made safety and more secure through universally-available, state-of-the-art 9-1-1 systems and trained 9-1-1 professionals. NENA is the only professional organization solely focused on 9-1-1 policy, technology, operations, and education issues.

[2] The street address of the calling party, plus additional information such as suite, apartment or similar information necessary to adequately identify the location of the calling party, per 47 CFR § 20.18(i)(1)(i).

[3] For the purposes of this filing, Originating Service Provider (OSP) means the same as Commercial Mobile Radio Service (CMRS) provider.

located; a door is not what location services produce when asked to provide a location; a door is not how mapping software (including geospatial routing of calls) works. All of these things handle a *location*, and a *location* is what OSPs should provide the 9-1-1 system. Not a door.

As the Commission and various commenters (including NENA) have noted, identifying one's altitude within 3 meters, when cross-referenced with a 3D dataset, is a reasonable benchmark for locating the floor on which a caller is located. However, NENA feels that simply adding a third physical dimension to 9-1-1 calling accuracy requirements that date back decades does not sufficiently reflect how location is handled in the modern world. This method fails to provide a future-proof, least-effort path forward toward NG9-1-1, or even the easiest path for OSPs to comply with the Commission's proposed rules. For this reason, we strongly encourage the Commission to consider that OSPs be required to deliver a geodetic Location Object (LO) to the 9-1-1 system.[4]

This approach will provide the best means for emergency services to locate and serve callers in three dimensions, provides the lowest technical and financial barrier to entry for OSPs, and provides a future-proof path forward and sets a baseline for *all* OSPs — not just CMRS providers — to follow, since they can all use the same interface to deliver a location object to 9-1-1.

Finally, we note that issues highlighted in CTIA's ex parte with the Commission, which lay out functional and sustainability issues with NEAD, leave us concerned that it is not a viable program. While additional funding and continued work may indeed make NEAD more effective, we express doubt that the NEAD will continue to keep pace with commercially available location services. Notwithstanding that

[4] Though NENA's definition of a geodetic LO in the context of this filing is described in greater detail below, in general, an LO is a data format that communicates latitude(s), longitude(s), elevation, uncertainty, confidence and the datum which identifies the coordinate system used, communicated in a standardized, encapsulated data format. This location may be expressed as a shape with a geodetic reference; in most cases this will be a point, but it could also be expressed as a circle or sphere (in the case of a search area around a point), a prism (in the case of an appropriately-shaped building), a line (in the case of a road centerline), for example. *See* NENA Master Glossary at 119.

the proposed rules do not treat dispatchable location delivered via NEAD equally with the proposed rules for location services, we urge the Commission to reconsider the use of NEAD as a means to comply with its rules.

I. The Commission's proposed accuracy thresholds are reasonable, but NENA urges the Commission to consider requiring OSPs to deliver a location object.

As a general matter, NENA finds the proposed accuracy thresholds — 3 meters of vertical accuracy and 50 meters of horizontal accuracy — reasonable. We argue, however, that instead of merely adding a vertical dimension to its current requirements, these thresholds be applied to the accuracy of the Location Object (LO) delivered by the OSP. We base this conclusion on (as elaborated further in this filing) (1) NEAD may not be the best platform for delivering dispatchable location, and (2) in the absence of using NEAD, there is no justifiable argument for the OSP not delivering the location it would have used to generate a dispatchable location to the NG9-1-1 system — especially from a mobile device that has purpose-built emergency location services built in.[5] Rather, the location should be delivered to the NG9-1-1 or 9-1-1 system in the form of an LO, which is standards-based, interoperable, and compatible with legacy 9-1-1 networks either via a gateway or a third-party Location Information Server (LIS).

A. The Commission should require computation of z-axis information as "height above ellipsoid" in meters.

Modern PSAPs use a multitude of software packages, from call-taking to computer-aided dispatching to mapping. Each of these systems relies on nationally- and globally-standardized mechanisms to consume location data. Many of these are the same standards to which carrier networks, ALI service providers, and end-user devices are built. For example, the two most common data structures for location information are the joint ATIS-TIA J-STD-036 (common in legacy platforms) and the IETF Presence

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[5] E.g., Apple HELO and Google ELS.

Information Data Format—Location Object (PIDF-LO) standard (the standard LO used in NG9-1-1 platforms).[6] Each of these standards generally presumes the delivery of z-axis information as a value in Height Above Ellipsoid (HAE) in meters, as defined in the World Geodetic System 1984 (WGS-84).[7] Additionally, NENA understands that certain 3GPP standards are also constructed to require the same representation. Because HAE is the globally recognized standard for delivering z-axis information, NENA believes that it is the sole z-axis representation that should be required by the Commission's rules. This will ensure that everyone — PSAPs, field responders, public safety software providers, carriers, carrier service providers, and handset vendors — can build interoperable systems that make use of a common data type.

Note that a reference ellipsoid is not an accurate depiction of the earth's surface or of mean sea level. It is a mathematical expression of the average mean sea level of the surface of the earth.[8] This expression provides for a universal reference to which any 3D dataset can be compared — for example, a jurisdiction's own 3D geospatial data or that of a third party — in order to identify height above ground and floor level. More importantly, the reference ellipsoid provides for a portable reference that facilitates interoperability for any z-axis measurement across any system. Since a reference ellipsoid can be expressed with a relatively straightforward mathematical expression, it does not require that a z-axis reference be stored anywhere; the model to express WGS84 is publicly available and can be recreated at any time, including directly into application source code. The mean sea level of the earth is not uniform

[6] See Presence Information Data Format (PIDF), RFC-3863, IETF Network Working Group, https://tools.ietf.org/html/rfc3863, and TIA J-STD-036, Enhanced Wireless 9-1-1 Phase II, TIA Standards Store, https://global.ihs.com/doc_detail.cfm?&csf=TIA&item_s_key=00366935&item_key_date=820612&input_doc_number=J%20STD%20036&input_doc_title=&org_code=TIA.

[7] *See* World Geodetic System (WGS 84), National Geospatial-Intelligence Agency, https://www.nga.mil/ProductsServices/GeodesyandGeophysics/Pages/WorldGeodeticSystem.aspx.

[8] *See e.g.*, Sandwell, David T.: *Reference Earth Model - WGS84*, https://topex.ucsd.edu/geodynamics/14gravity1_2.pdf.

and cannot be mathematically expressed.[9] In contrast, there are discrepancies between a reference ellipsoid and the actual surface of the earth are not only known, but are also easily documented and recreated.

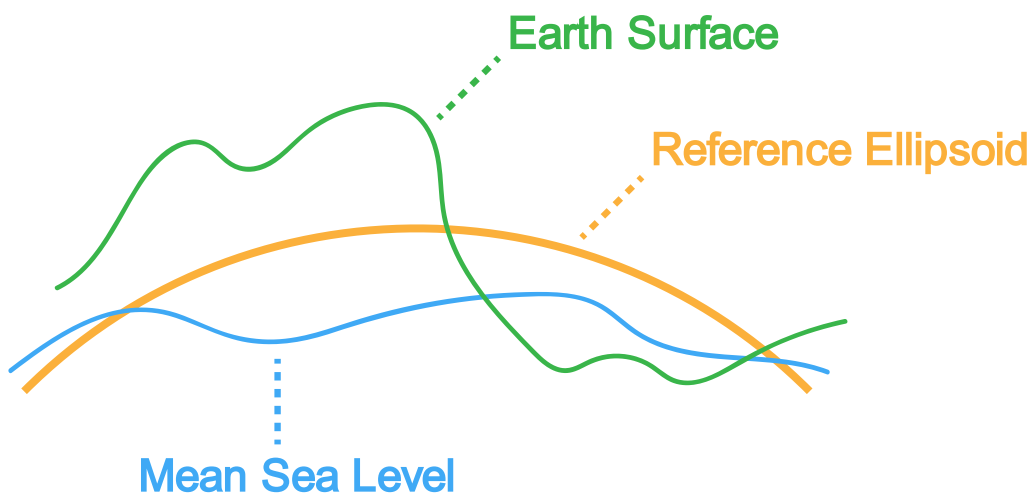

Figure 1: Illustration of the Uniform Reference Ellipsoid Height Relative to Mean Sea Level and the Surface of the Earth

In addition, NENA believes it is critical that *all* location information, including z-axis, include detailed uncertainty information. Recent advances in the availability of geodetic location data have demonstrated the clear benefits of providing telecommunicators with a visual representation of that data. Although many current PSAP systems cannot provide 3D visualizations, NENA believes that the availability of this data will drive adoption of systems that can. Perhaps more importantly, however, NENA believes that this data will be crucial to the evaluation of "floor level" information, once one or more reliable sources for that preferred representation become available.

[9] *See Mean Sea Level, GPS, and the Geoid,* by ESRI: "The three-dimensional surface created by the earth's sea level is not geometrically correct, and its significant irregularities could not be mathematically calculated . . . [for example, ESRI headquarters is] approximately 400 meters above MSL . . . However, a precise, nonadjusted GPS reading for the same location typically shows the elevation as 368 meters." Retrieved online May 20, 2019 at: https://www.esri.com/news/arcuser/0703/geoid1of3.html.

B. The lack of a publicly-available authoritative reference model for floor level or in identifying room number highlights the perils of the OSP providing dispatchable location.

While NENA continues to believe that "floor level" information is the fastest and most reliable means of communicating vertical location information in human-readable form (particularly over legacy voice radio systems that lack data and display capabilities), we are concerned that the premature use of such information may result in the introduction of avoidable errors. Consequently, we caution the Commission against requiring such a representation at this time.

We note that floor-level information is included in IETF's specification for PIDF-LO as an optional element included with a civic location.[10] However, as a general practice, the location as a geodetic expression is primary, while civic location (dispatchable location) is secondary.[11] This is in keeping with the reasoning that the conveyance of a specific address and room number without a transparent expression of the underlying uncertainty in locating that room number is nearly as dangerous as providing no location at all.

An authoritative reference source for the number and height of floors in a given building does not currently exist. Some localities have begun to collect this data as part of the introduction of Geospatial Information Systems during the transition to Next Generation 9-1-1, but NENA is unaware of any system currently capable of validating, ingesting, or displaying numeric floor data today. Consequently, it is not possible for existing systems to determine whether a particular floor-level location estimate is valid and trustworthy. This can increase response times, sow confusion among field responders, and further reduce the already-tenuous trust many telecommunicators place in OSP-provided location information. Moreover, this lack of an authoritative reference points to the need for a managed transition to human-

[10] *See* IETF RFC 5491: GEOPRIV PIDF-LO Usage at 2, https://tools.ietf.org/html/rfc5491.

[11] *See* id. at pg. 6: "Where the compound location is provided in a single <location-info> element, the coarse location information MUST be provided first. For example, a geodetic location describing an area and a civic location indicating the floor should be represented with the area first followed by the civic location."

readable z-axis information — one that occurs on a timeframe set by the availability and completeness of local validation sources such as an NG9-1-1 Location Validation Function (LVF).

Second, there also exists no reference, authoritative or otherwise, that can accurately determine, validate, or ingest floor labels. As noted above, the myriad differences between floor indices and floor labels across buildings even in a single city presents significant risks to floor-based location systems. Worse, these risks would be greatly amplified were locations to be presented without accompanying geodetic information. Under such circumstances, neither OSPs, 9-1-1 service providers, PSAPs, nor PSAP software providers could implement "sanity checks" to confirm that a reported floor number falls within a reasonable vertical uncertainty of a reported fix. Such checks have been important to public safety use cases in the past, and likely will continue to be, whether they are conducted on-device, by a carrier, by a carrier vendor, at a PSAP, or in each of these possible systems.

Lastly, allowing public safety agencies the freedom to use more accurate local data sources to produce a single, authoritative geodetic-to-civic reference will preserve the power of local PSAPs to choose software and hardware that best meets their needs, while simultaneously minimizing induced errors from multiple transformations between these two formats.

II. Requiring OSPs to provide a location object is reasonable and beneficial to NG9-1-1.

NENA urges the Commission to consider requiring location be delivered to the NG9-1-1 system as an LO conveyed over IP. We feel that this request is reasonable given that (1) an LO with geodetic information provides the lowest barrier to entry, (2) location as argued for in this filing is a well-established concept in prevailing applicable technical standards, and (3) in accordance with standards, existing systems are ready or nearly ready to ingest location in this fashion. Not only is this request reasonable, but it also establishes an environment that facilitates at least a basic feature in NG9-1-1 that has been developed in standards for years: handling of location in an IP environment.

A. A location object with geodetic information provides the lowest barrier to entry for market participants.

Supporting delivery of an LO represents the lowest barrier to entry to three-dimensional location for OSPs. Functions like Google's Emergency Location Services (ELS) and Apple's Hybridized Emergency Location (HELO) provide no direct cost 9-1-1, as the functions that drive these features are motivated by the ever-increasing need for consumers to have highly accurate, fast location estimates on their smartphones. ELS and HELO are already capable of being delivered directly to the PSAP either through the OSP or through a third-party LIS, such as RapidSOS (as they are already doing today).

Indeed, though the specifics of how ELS and HELO function are not available to the general public, the core function of NEAD — referencing WiFi access points against a database of their known locations — is not only included in these commercial location services but is also automatically maintained by context-aware Artificial Intelligence.[12] These services cross-reference available access points with GPS, cell tower and sensor data.

B. Location is a well-established concept in relevant prevailing technical standards.

PIDF-LO is an international standard for providing an LO that includes geodetic information in a variety of forms, which can include a point or a shape as well as a civic address. An LO — and specifically PIDF-LO — is a concept built into the prevailing standards used for NG9-1-1, including Location-to-Service Translation Protocol (LoST) — the international standard that enables a caller's location to be mapped with services available at that location[13] — and the NENA i3 Standard for Next Generation 9-1-1 (for example, NENA-STA-010.3-2019 3.4, LoST, details how LoST protocol is

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[12] See *Control access point inclusion in Google's Location services.* Retrieved May 20, 2019 at: https://support.google.com/maps/answer/1725632?hl=en

[13] See IETF RFC 5222, LoST: A Location-to-Service Translation Protocol.

integrated into NG9-1-1, such as how it is used by various functional elements in core services such as location-based routing).[14]

Note that LoST and i3 can accommodate a civic address. Should the Commission decline to require OSPs deliver geodetic information as an LO, and instead decide to implement requirements for a dispatchable location as defined, NENA requests the Commission to consider establishing the requirement to deliver that dispatchable location as a civic address in an LO.

C. Existing transitional NG9-1-1 systems in the United States are ready to receive a location object. Those that cannot receive a location object directly can receive location information from a data repository. In both cases, the OSP provides an LO.

According to information collected by NENA and the National 9-1-1 Program, we estimate that there are at least 20 states that have substantial, i3-based transitional NG9-1-1 deployments either currently operational or in-progress — and this number is rising.[15] These systems are either already able to receive a standards-compliant LO or are able to receive an LO with minimal modification. The figure below depicts states in which there is a substantial NG9-1-1 deployment according to our records as of May 2019.

[14] See NENA-STA-010.3-2019 ("i3") 3.4, LoST. (Draft) retrieved May 20, 2019 at: https://dev.nena.org/higherlogic/ws/groups/eca27a3d-a4c7-4d67-bb06-b3bb241df44e/documents/20192477/document?document_id=16091.

[15] See *Status of NG9-1-1 State Activity,* by NENA: The 9-1-1 Association. Retrieved May 20 2019 at https://www.nena.org/general/custom.asp?page=NG911_StateActivity. See also *2017 National 911 Progress Report*, US National 911 Program. Retrieved May 20 2019 at https://www.911.gov/pdf/National-911-Program-Profile-Database-Progress-Report-2017.pdf.

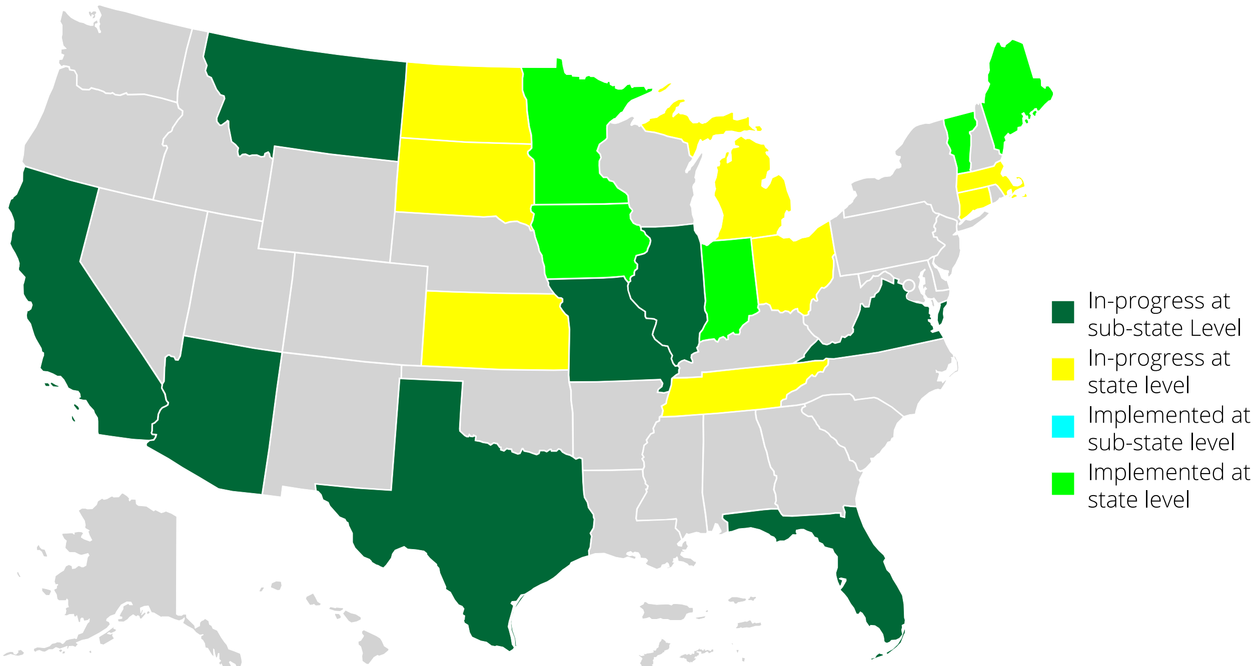

Figure 2: NG9-1-1 Deployments in the United States as of Q4 2017

On an interim basis, a PSAP can receive LO information through a third-party LIS[16] that either holds the payload of the LO itself or a reference to that location available elsewhere (such as by reference to carrier location services). A simplified architecture of this solution is illustrated below, in which a PSAP receives a 9-1-1 call from a DBH-capable device. When the caller places a 9-1-1 call, their call is handled by the 9-1-1 system normally. Simultaneously, their location is made available via location services to a valid, approved LIS. Upon receiving the call, the PSAP queries the LIS, which in turn provides access to cellular location services.

[16] i3 at 4.10 and 4.11.

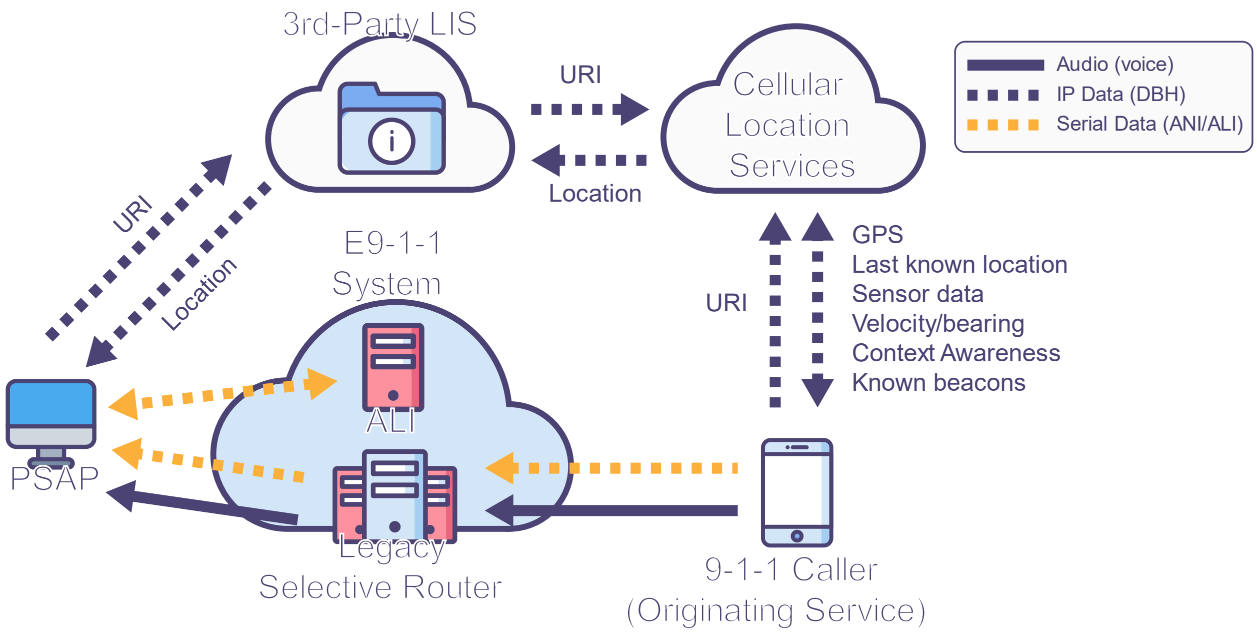

Figure 3: Location Object Delivered Via Third-Party LIS (simplified diagram)

This is a solution that exists in the market today and is used by PSAPs across the nation and is available for most handsets in the United States.[17] However, the originating service provider is not required to make this information available to the 9-1-1 system; it is provided over the top as a best-effort service, and is not necessarily provided in compliance with any standards and not necessarily interoperable in any meaningful way. However, the fact that this product exists in the market today shows that it is a technically viable approach, and that it is reasonable to request OSPs to provide an LO using DBH.

Finally, DBH is in many cases delivered via ALI today, delivering high-tech location services over a legacy serial data connection. NENA asks that the Commission only consider a mandate that OSPs deliver the same location information that they deliver today — only that they be required to utilize

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[17] See, e.g., *Apple's iOS 12 securely and automatically shares emergency location with 911*, retrieved May 20 2019 at: https://www.apple.com/newsroom/2018/06/apple-ios-12-securely-and-automatically-shares-emergency-location-with-911/ and see e.g. *Google and RapidSOS Now Provide Emergency Location for 911 Calls Nationwide*, retrieved May 20 2019 at https://rapidsos.com/blog/google-and-rapidsos-partner/. NENA does not endorse Apple, Google or RapidSOS and provides these as examples only.

established, modern standards to do so. These functions are nothing new: NENA's i3 is a well-established and commonly accepted standard in the United States and beyond;[18] work on the standard has been going on for decades, and most of its underlying elements are taken from IETF standards, which constitute part of the basic definition of the global internet.

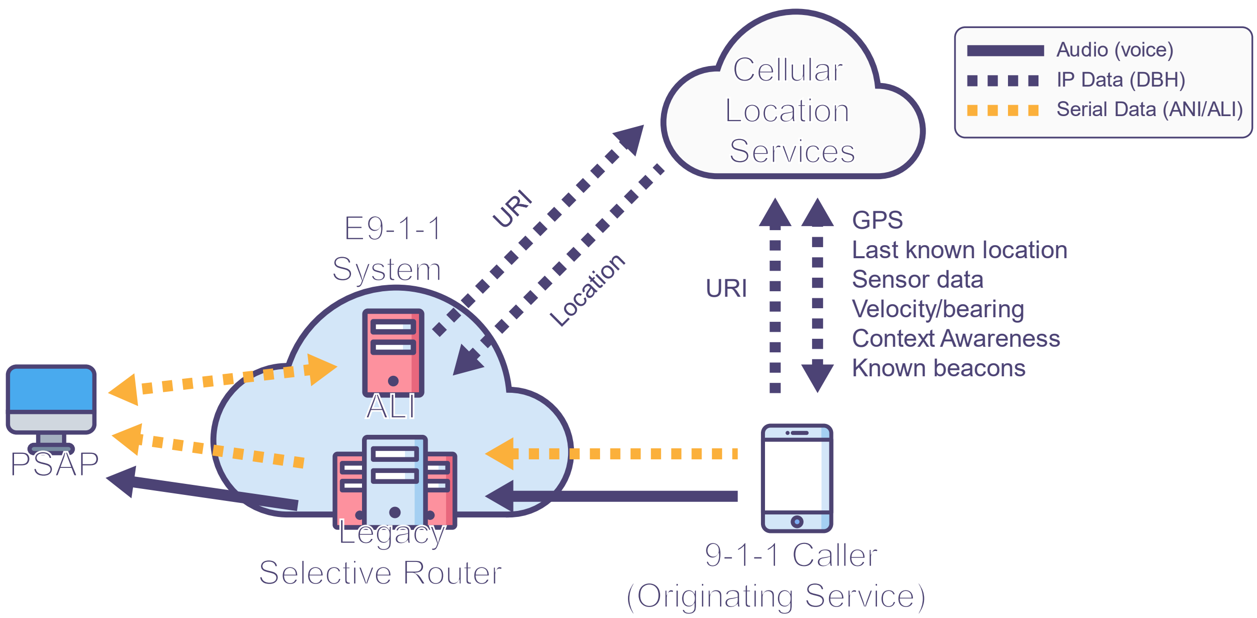

Figure 4: DBH Location Information Injected into ALI (simplified diagram)

D. The Commission must consider a location fix as a dynamic set of values that can improve over a period of time measured in seconds; and in establishing its rules, the Commission must consider *routable* location compared to *actionable* location.

We note that in using location services, the Commission should consider two concepts in its accuracy rules: *routable* location versus *actionable* location. Should the Commission consider delivery of an LO in its rules, this distinction becomes important in evaluating location accuracy, including on the z axis.

A coarse location, such as a location with a large search area, is sufficient to connect the caller with the appropriate answering point. Meanwhile, a precise location can be improved by taking additional

[18] Canada's planned national NG9-1-1 system is built to the i3 specification, while Europe's NG1-1-2 standard is based on i3.

samples, which can then be delivered to the PSAP after the call has begun ringing or even several seconds after it has been answered.

Generally, with location services, more samples (and more time) leads to more precise location. Anyone can observe this on their own smartphone by opening up a mapping application and observing that it first shows a large circle around their estimated location which gradually shrinks until location services more precisely locates the device. This user experience is meant to communicate, in general terms, the precision of the fix from location services.

Reducing call setup time is critical to 9-1-1, and there is no reason to wait longer to route a call than is minimally necessary. It is possible in NG9-1-1 to route with a coarse location (e.g., a point with greater than 100m accuracy) and to later (in a time measured in seconds) increase precision, e.g. to <10m. This is somewhat analogous to rebidding location in wireless E9-1-1. A coarse location is available from location services almost immediately and that coarse location is likely to be sufficient to route to the correct PSAP. It will take at least several seconds to answer a call, and at least several more to dispatch it. The caller's precise location can be determined during this time. This approach is fully consistent with prevailing NG9-1-1 standards. The concept is illustrated below.

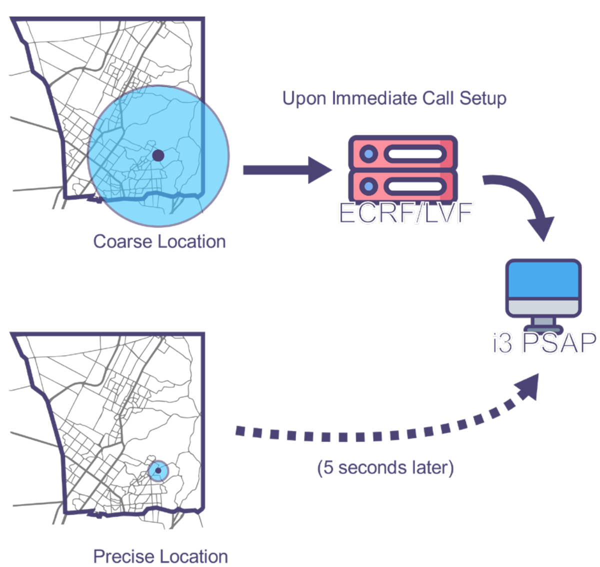

Figure 5: Routing with Coarse Location and Later Establishing Precise Location

In establishing future location accuracy rules, particularly in light of how location services work, the Commission must consider to strike a balance between what is a reasonable time frame during which to deliver coarse (routable) location compared to precise (actionable or "dispatchable") location, and to evaluate service providers accordingly.

III. The Commission's Requirements for vertical location accuracy do not treat z-axis and dispatchable location equally.

In its *Fourth Report & Order*, The Commission provided CMRS providers with an option: within six years of the order's effective data, they must "deploy either (1) dispatchable location, or (2) z-axis technology that achieves the Commission-approved z-axis metric."[19] Deployment requirements for dispatchable location differ vastly from those for z-axis, however. For dispatchable location, the Commission stipulated that "the [NEAD] must be populated with a total number of dispatchable location reference points in the CMA equal to 25 percent of the CMA population," and where z-axis is used, CMRS providers must deploy z-axis technology "to cover 80 percent of the CMA population."[20] While the 25 percent metric was calculated using relatively sound math, it is based on broad assumptions about the equal distribution of access points across buildings and the equal distribution of 9-1-1 callers inside those buildings. These assumptions disregard, for instance, significant commuter populations found in the top CMAs, vastly differing densities of access points found in these areas, and the varying difficulties with which CMRS providers have been able to recruit access point database owners to the NEAD cause. The possible result is a grossly unequal distribution of access points, leaving large swaths of CMAs uncovered by the NEAD but still meeting the requirements stated in the *Fourth Report & Order*.[21] Z-axis, technology, on the other hand, has more expansive gross coverage requirements and will by nature be more evenly and predictably applied over a given CMA.

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[19] 4th R&O at para 6.
[20] 4th R&O at para. 103.
[21] 4th R&O at para 114, citing Addendum at 3.

IV. Geodetic location information provides the best information for 9-1-1 to locate callers and dispatch responders appropriately.

While a field responder will eventually require a "door to kick in," that responder will likely not require the name of that door immediately, and dispatch operations may in fact be hindered by the *lack* of information inherent in a single, yes-or-no address delivered by an OSP. Rather, geodetic location expressed as an LO represents the best means for an OSP to accurately convey the certainty of an individual's location, without misleading the telecommunicator, while empowering them to use the same tools the OSP would otherwise use to locate the person.

A. Dispatchable location, while actionable, reduces the amount and quality of information that eventually reaches the PSAP.

NENA's stance in these comments rests largely on the difference in how humans and computers receive, retain, and compute location. The lack of precision inherent in a civic address is clearly understood in the mapping marketplace, as evidenced by companies like what3words.[22] However, x/y/z coordinates have their limitations in the human mind: very few people can retain and relate coordinates of the appropriate precision—a degree of latitude is roughly 69 miles long, so 1m of precision requires latitude be expressed to the 5th decimal place (1/100,000th of a degree). The difficulty of using latitude and longitude is compounded by not only the varying distance of a degrees of latitude and longitude at different parts of the planet, but also by the difficulty in accurately conveying these distances verbally. Computers, on the other hand, have no problem handling this sort of information. Because the system of latitude and longitude is more accurate, precise, and logically consistent than civic addresses, computers and networks in almost all circumstances handle locations natively in terms of latitude and longitude—the "conversion" to civic address generally only happens just prior to the human interface. This is because

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[22] what3words is a company founded because "addressing around the world should be better," and because "street addresses are often night precise enough, and don't exist in parks, rural areas, or rapidly developing places." what3words has "divided the world into a grid of 3m x 3m squares and assigned each one a unique 3 word address" in order to demarcate geographic locations in a way that is more precise than a street address but easier to remember and recite than a latitude/longitude. *See* https://what3words.com/.

converting to civic address, no matter how precise, inherently strips some degree of precision from the latitude/longitude measurements recorded by a modern method of location determination, such as the Device-Based Hybrid location used by nearly all smartphones today.

B. If provided a location object, then 9-1-1 jurisdictions will have access to the same tools that OSPs have to convert a location object into a civic address. However, a civic address cannot be accurately converted into the actual location of the caller.

As we made clear earlier, a civic address is inherently less precise than an LO. Thus, to convert an LO to a civic address inside a computer is to reduce the precision of that object. Thus, absent some additional data regarding, for instance, the radius of an address or an uncertainty level, it makes little sense for 9-1-1 to receive an imprecise civic address from an OSP. Indeed, 9-1-1 has access to the same reverse-geocoding tools available to OSPs, and can convert location objects to civic addresses if necessary, while still retaining potentially crucial information regarding a caller's exact location in space as well as the certainty in acquiring that location.

C. A "failure" or false positive of dispatchable location is far more dangerous than an imprecise geodetic location.

Much more damaging than an imprecise location is a precise location that is confidently wrong. By requiring OSPs to deliver a dispatchable location, telecommunicators are beholden to whatever "black box" technology is used to provide that location.[23] Whatever ancillary or additional information is available to the telecommunicator, the OSP provides a civic address and suite number: an extremely specific location. If that address is in any way incorrect, then it is potentially much more harmful than a geodetic location that has a low degree of precision.

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[23] For example, NEAD's public-facing website provides barely a paragraph describing how it works or how it interfaces with external systems. See: *The National Emergency Address Database: Enhancing Indoor 9-1-1 Location Accuracy* http://www.911nead.org/, retrieved May 20 2019.

Given a regime in which the OSP is required to deliver dispatchable location, in reality, a telecommunicator will receive that dispatchable location from the OSP *in addition to* location information delivered over-the-top, such as through a third-party LIS and, finally, any information relayed by the caller.[24] The telecommunicator would make the best decision based on the information available, as they do today.

Reverse-Geocoding of Location is not a Suitable Substitute

In general terms, a bad location will give a bad address. A location is converted to a civic address through reverse-geocoding; a location is provided to a mapping service, which looks up the closest address based on the location provided to it. In the case that the source location is imprecise, reverse-geocoding provides the telecommunicator with certain, but misleading information. The diagram below illustrates an example where the location provided to the reverse-geocoding engine has a high degree of uncertainty. However, the engine gives a specific location: hypothetical 1234 NENA Blvd.

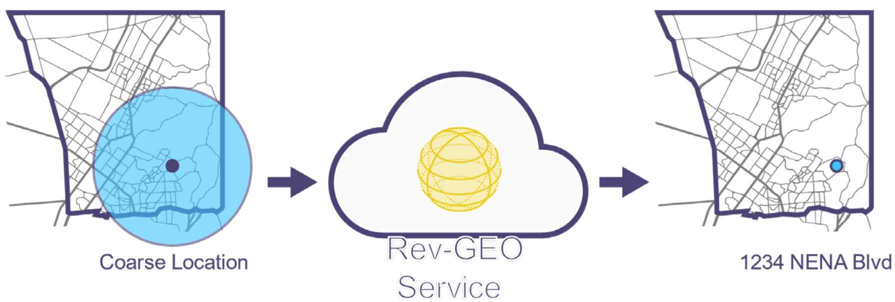

Figure 6: Converting a coarse location into a dispatchable location

For a real-world scenario, NENA provided a location to Google's Reverse Geocoding Service[25] in Rock Creek Park, Washington, D.C. This location was chosen as a good candidate environment where a reverse-geocoding service could provide a bad dispatchable location, because it is a high-traffic urban

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[24] For example, RapidSOS provides location services via a web client or directly to an end-user application through their API via Apple HELO or Google ELS. See, e.g., *Google and RapidSOS Now Provide Emergency Location for 911 Calls Nationwide*, retrieved May 20, 2019 at: https://rapidsos.com/blog/google-and-rapidsos-partner/. Provided for example only. NENA does not endorse RapidSOS or any software vendor.

[25] See developer documentation for *Google Maps Developer Documentation, Reverse Geocoding*, retrieved May 20 2019 at: https://developers.google.com/maps/documentation/javascript/examples/geocoding-reverse. NENA does not endorse Google or its Google Maps product.

park with many walkways and trails located nearby multi-story buildings in a dense urban environment. In the example below, a fix within the Commission's rules of 50 meters horizontal accuracy is equally likely to reverse-geocode to Morrow Drive NW or Beach Drive NW. However, the reverse-geocoding service provides only the location "Morrow Drive" with no additional context or even a mile marker.

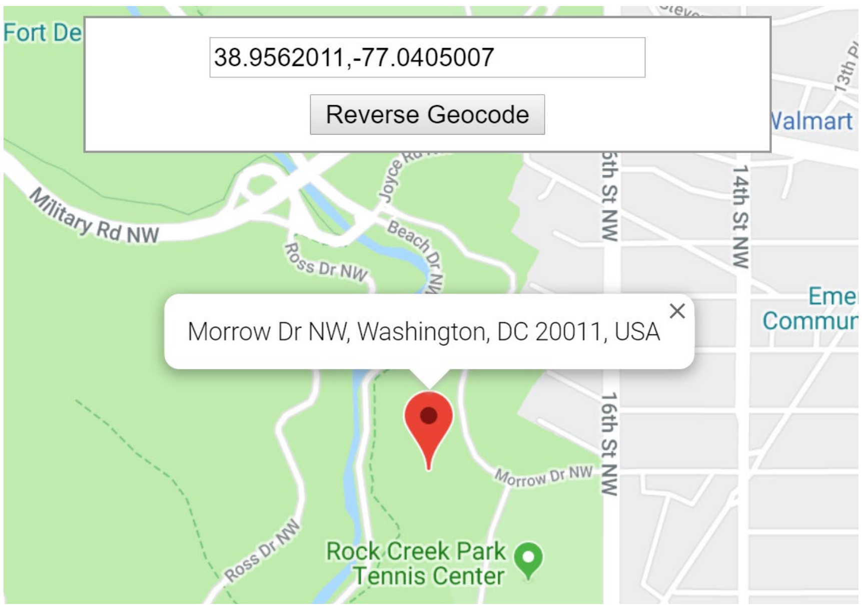

Figure 7: Sample Location Fed into Google Reverse-Geocoding Service

This example highlights two concerns: (1) that precision location information is converted to something less precise ("Morrow Drive NW") and that (2) the service is only as good as the address it is able to look up. In this case, understandably, the reverse-geocoding service is not particularly accurate, as Rock Creek Park is a recreational area, and there is relatively little public demand for precise mile marker locations via a mapping service. However, the local authority itself—in this case, the US National Park Service—certainly *does* have a requirement to maintain highly accurate information about the park in its own geospatial data, including picnic areas, mile markers on roads and trails, and even restroom locations. In this case, the OSP delivering a dispatchable location does nothing for them, and in fact, impairs their ability to respond, relative to the geodetic location they could otherwise receive via an LO. The Park Service itself could, however, reference the original location with their own geospatial dataset and correctly locate the caller located at, for example, a picnic area located at that precise location off of a named nearby walking trail.

While this example is not directly relevant to indoor positioning, it is relevant to the argument that the OSP should pass the original location to the NG9-1-1 system, rather than computing a dispatchable location and providing the dispatchable location to the NG9-1-1 system—not only is it potentially less accurate than the location the OSP originally retrieved, but also the NG9-1-1 system can perform the same operation itself with greater transparency to its accuracy. This same argument applies to any architecture that would input a location object into a service to generate a dispatchable location, including one that uses 3-dimensional building data to provide a floor-level measurement or a more granular indoor location.

NEAD, of course, does not use location services or reverse-geocoding, and so does not suffer this limitation. Also, as mentioned above, the telecommunicator will also have access to location provided by location services via a LIS and/or assisted GPS, as well as information relayed by the caller. However, should the Commission (1) require that OSPs deliver a dispatchable location, and (2) NEAD proves itself not a viable or cost-effective solution, OSPs may indeed turn to reverse-geocoding as their only remaining option. A reverse-geocoding engine will, indeed, provide the best civic address it has, every time, regardless of the quality of that address information or the original location fed to it.

The Commission should consider the scenario in which an incorrect civic address and suite number is provided, which, based on available information, is likely to happen frequently under a dispatchable location regime.

The examples below illustrate the potential in which the wrong civic address and suite number is provided, which is a genuine concern for reverse-geocoding engines (as argued above) as well as for NEAD, which was successful in providing a dispatchable location less than half the time and provided a valid civic address for the *wrong* building nearly 10% of the time.[26] The illustrations below depict the

[26] See NEAD Report at 4: "82.6% of valid test calls resulted in some kind of Civic Address delivered (be it correct or incorrect.) . . . 17.4% of valid test calls produced no Civic Address . . . and 8.6% of valid test calls produced an incorrect street address (an address of a neighboring building.) . . . 38.7% of valid test calls produced an accurate DL2 or DL1 result"

value of communicating the location object directly into the NG9-1-1 system, rather than relying on the OSP to compute the individual's dispatchable location and providing that to the telecommunicator.

This scenario involves a caller, who is located on the second floor of a multistory building. They place a 9-1-1 call.

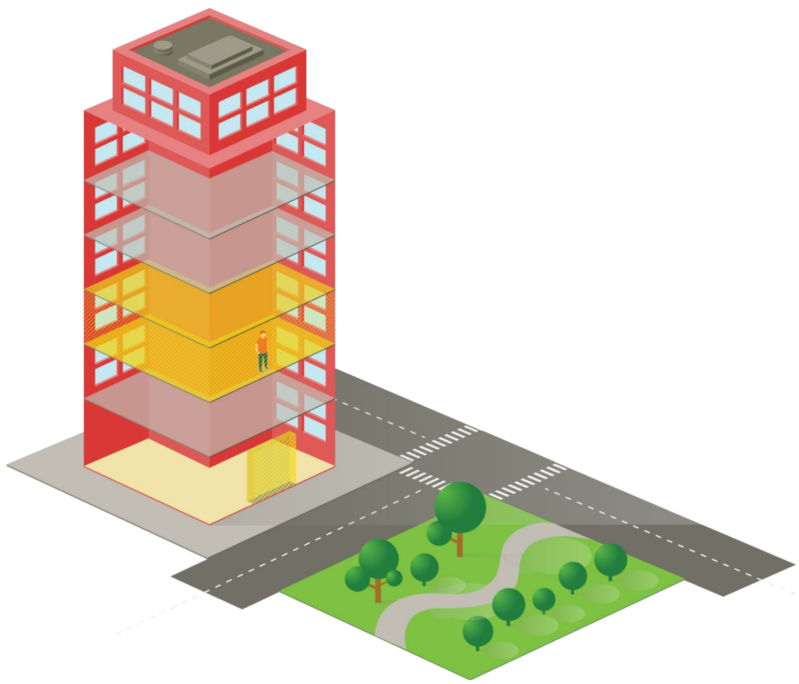

Figure 8: Depiction of Civic Address and Z Axis Measurement

The figure above depicts the Commission's metric, in general; a civic address with a floor number, or DL1.[27] This location could be identified with NEAD, where the floor level and civic address of each WiFi beacon is registered in the database, or via a z-axis metric provided by measuring altitude (e.g., as with compensated barometric pressure) and a reverse-geocode using location services and a 3D dataset. In most cases, this is sufficiently actionable information to respond to a call. However, if the OSP uses measurements from the device (such as a pressure measurement and location services) to determine this location, then there is no justifiable reason that the OSP should not pass those measurements into the

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[27] DL1 is civic address, building zone or quadrant and a floor that the call was made from. *See* ATIS Emergency Services Interconnection Forum, *Guidelines for Testing Dispatchable Location*, ATIS 0500035, § 9.2

NG9-1-1 system which can perform the same reverse-geocoding measurement itself while retaining full insight into the quality of the original location provided.

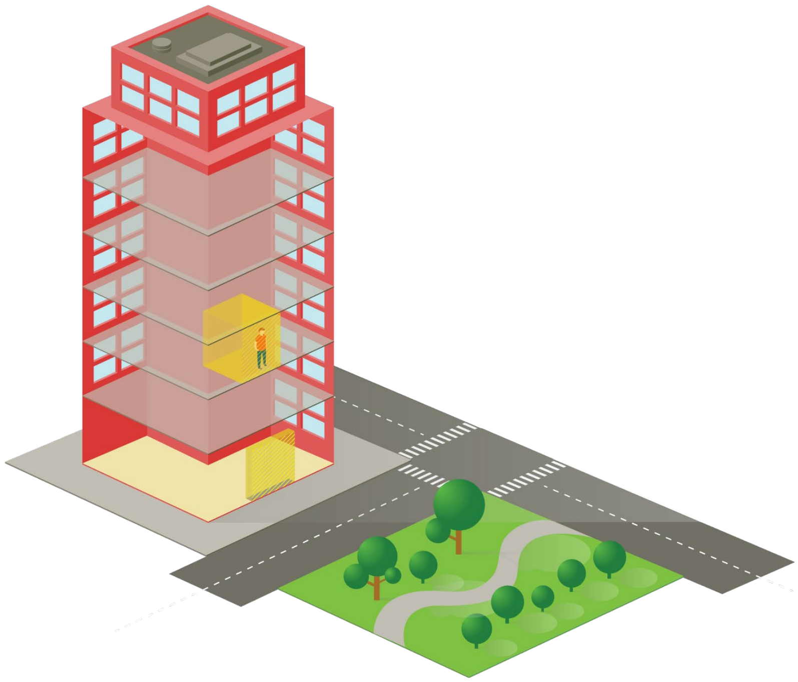

Figure 9: Depiction of Civic Address and Suite Number

The figure above shows an ideal scenario for dispatchable location, depicting DL2, or the specific suite number that the system believes the individual is in.[28] This is the use case that NEAD is designed for. However, in the absence of NEAD (such as in a market outside of the top 50 CMAs or if NEAD is determined to not be a viable program), it can also be determined via referencing a location to a three-dimensional dataset. However, as shown in the Google Maps Reverse Geocoding Service example above, the address will only be as good as the data referenced and the location provided. If the OSP is required to deliver a dispatchable location as defined instead of an LO, then the caller location may be delivered with a misleading degree of certainty. If the OSP uses any sort of reverse-geocoding service using location services, then there is no justifiable reason that the OSP should not pass the original location data into the

[28] *See* Id. DL2 is the civic address and room/suite that the 9-1-1 call was made from, including floor.

NG9-1-1 system. The jurisdiction may choose the same available dataset the OSP would have used or may otherwise choose the best available option.

Figure 10: Depiction of Incorrect Dispatchable Location

The figure above shows the scenario that the test bed encountered nearly 10% of the time with NEAD: a valid dispatchable location with the wrong civic address.[29] Noting that NEAD LLC documented its database during testing was in the "early" stages of provisioning,[30] this is nonetheless one of the risks of requiring OSPs to deliver a dispatchable location: an address and suite number is a very specific location that will sometimes be incorrect. This is much more harmful to the response than having an unclear impression of where the caller is location, as it may result in first responders being sent to the wrong place.

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[29] NEAD report at pg. 4.
[30] Id. at 3.

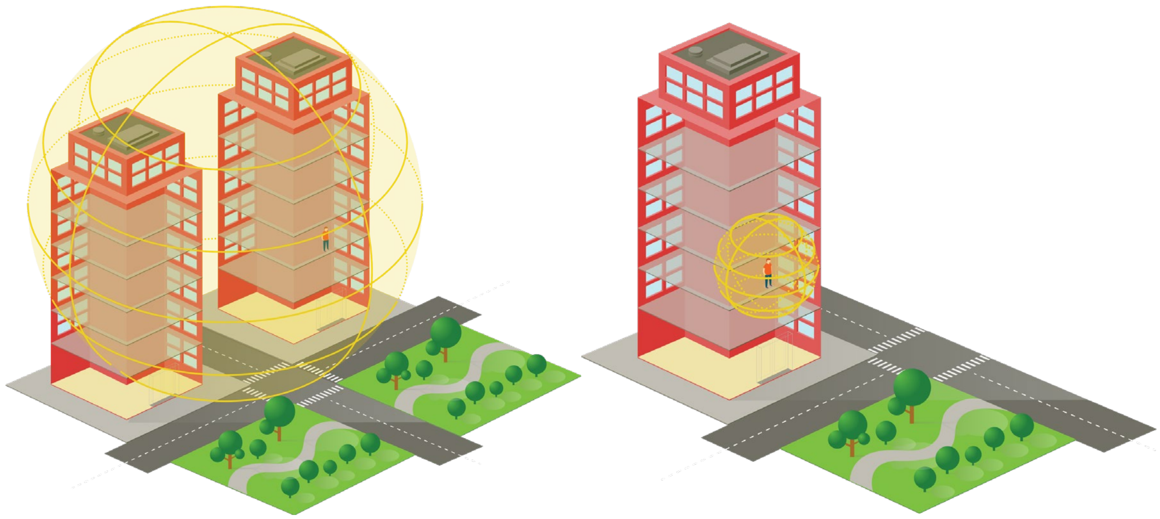

Figure 11: Depiction of Coarse Vs. Precise Location in Three Dimensions

The figure above depicts a relative search area for two cases: on the left, a location with a low degree of certainty on both the horizontal and vertical dimensions, and on the right, a location with a high degree of certainty in both dimensions. In each case, the actual location information could be conveyed in an LO as a point with a horizontal uncertainty (e.g., 50 meters) and a vertical certainty (e.g., 3 meters), which in this illustration is depicted as a spheroid. In those cases where the caller simply cannot be precisely located, this information should ALWAYS be transparently communicated to the 9-1-1 system and to the telecommunicator. This information can be conveyed in a standards-based, interoperable format in the form of an LO. It is not conveyed in a transparent matter with dispatchable location, even though the dispatchable location can be delivered within an LO.

V. In light of recent developments, NENA is concerned about the viability of the NEAD program

As noted by CTIA and others, the NEAD has a number of limitations. As an initial matter, while the NEAD has been successfully demonstrated and tested, it still lacks the reference point density and is prone to gross location errors, such as successfully delivering an improper address.[31] Further, the NEAD

[31] See Test Bed Z-Axis Report at 4.

lacks the same substantial economic incentive for continued management and evolution as privately managed databases of access point.[32] Reasonable improvements to the NEAD's database logic as well as increased participation by third parties may improve the viability of the NEAD, but these advances are certainly not guaranteed. Additionally, the Test Bed reported difficulty in securing widespread vendor support.[33] During the creation of the Roadmap, parties assumed that handset manufacturers and owners of large access point databases would participate willingly in NEAD database development. Unfortunately, that process has proven "challenging".[34]

While the NEAD's initial hurdles may eventually be overcome with significant effort, continued improvement and maintenance of the database has little additional economic incentive for participants. As argued earlier in this filing, commercially-available location services are better able to locate an individual, and an NG9-1-1 system may secure actionable z-axis location (such as floor level or suite number) either (1) through location services that provide a floor level and/or room number natively in an LO or (2) by referencing an LO that includes a z-axis measurement against 3D datasets available to the 9-1-1 entity. A similar approach is already in place today, albeit over-the-top as a best effort service (in the case of a third-party LIS) or injected directly into the ALI. We anticipate this will continue into the future even if NEAD is fully deployed and OSP utilization of the NEAD is mandated by the Commission.

We note that NEAD faces considerable sustainability issues; even in the Test Bed, where the platform would provide better-than-normal results,[35] it was only able to provide dispatchable location for fewer than half of calls. This is a result achieved through a significant amount of effort and human maintenance. Meanwhile, our filing explains earlier that in commercial location services WiFi access points are

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[32] ATIS notes in the E911 Location Test Bed Dispatchable Location Summary Report that its results "reflect the capabilities of an emerging technology, rather than the capabilities of a complete, ready-to-deploy system." Test Bed Report at 3.
[33] ATIS report at pg. 3.
[34] CTIA NEAD Dispatchable Location Report Ex Parte at 3.
[35] NEAD Report at pg. 3: "For testing to yield the necessary insights into wireless network performance, test buildings were intentionally chosen with at least some, even if limited, NEAD database coverage. Consequently, results of this campaign tend to skew towards an optimistic assessment of database completeness."

registered automatically with no human interaction; generally, unless one explicitly opts out, a large number of devices will measure the estimated location of any given access point and will continuously update a register of their estimated locations. A program like NEAD will always struggle to keep up because it does not have hundreds of millions of potential probes (i.e. consumer phones that passively collect data) constantly estimating access point location.

VI. Conclusion

NENA hopes that this comment is informative and spurs discussion on the rapidly evolving factors surrounding vertical location accuracy for 9-1-1 callers. We thank the Commission for the opportunity to comment on this important matter and welcome any follow-up questions.

Respectfully submitted,

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